a mobile chest automatically breathes deeply. Anyway, these functions are tied together in this compensatory way.

Many other intersting aspects of these data will be given in the complete publication to be issued by the American Museum of Natural History. It is hoped that when fully presented these data will give a true picture of the ranges and variabilities for these functions in a group of males selected at random, a sample of our population.

TABLE OF CORRELATIONS

18—27 years	n	r
Pulse 1 and 2	163	+0.73
Pulse 1 and 3	164	+0.85
Pulse 2 and 3	163	+0.86
Pulse 3 and Mobility	159	+0.12
Pulse 3 and Blood Pressure (D)	155	+0.06
Pulse 1 and Respiration Rate	171	+0.45
Pulse 3 and Respiration Rate	155	+0.25
Pulse 1 and Temperature	170	+0.22
Mobility and Vital Capacity	149	+0.47
Mobility and Respiration Rate	170	−0.34
Respiration Rate and Temperature	171	+0.05
Respiration Rate and Blood Pressure (S)	171	−0.03
Blood Pressure (S) and Pressure (D)	177	+0.15
Blood Pressure (S) and Temperature	171	+0.06
18—45 years		
Pulse 1 and Temperature	385	+0.20
Mobility and Respiration Rate	388	−0.46

STUDIES OF THE LARGER TERTIARY FORAMINIFERA FROM TROPICAL AND SUBTROPICAL AMERICA

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For more than a year I have been principally engaged on an investigation of the Tertiary larger foraminifera of America in order to make more secure the basis of certain geologic correlations, to extend the correlation ring in the Caribbean region, and to work out in more detail the morphological features of the species of several genera, especially the genus *Lepidocyclina* and its allies. Some of the results of these investigations are here reported.

Dictyoconus in Florida.—The discovery of specimens of *Dictyoconus* in material from surface exposures, considered by C. W. Cooke as of Oligocene age, near Live Oak, Florida, suggested the desirability of comparing with them the specimens from Florida wells identified by J. A.

Cushman as *Orbitolina*, and on which he based his opinion that deposits of Lower Cretaceous age occur at relatively shallow depths in Peninsular Florida.[1,2] A number of specimens examined by Doctor Cushman were kindly lent me by Mr. Herman Gunter, State Geologist of Florida. Many, if not all, of the specimens identified by Cushman as *Orbitolina* prove to belong to the genus *Dictyoconus*[3,4] and, although in many respects similar to, they are not the same as the *Orbitolina* from the Lower Cretaceous of Texas. The specimens from a depth of 1790 feet at Marathon, Florida, belong to the same species as specimens found in surface exposures near Live Oak; and a specimen from a depth of 1850 feet in the same well apparently belong to a species, *D. codon* Woodring, ms., common in the Eocene Plaisance limestone of Haiti.[5] There is no known evidence of deposits of Lower Cretaceous age occurring at relatively shallow depths in Florida, the deposits considered by Cushman as of Lower Cretaceous age being, according to the material I have examined, of either Oligocene or Eocene age.

Orthophragmina in the Ocala Limestone of Peninsular Florida.—The Ocala limestone in Peninsular Florida was correlated by Cooke[6] with the upper Eocene Jackson formation of Mississippi on the basis of its molluscan fauna. Later Cushman described species of *Lepidocyclina*, *Operculina*, and *Heterostegina*, but did not record any species of *Orthophragmina*. Because of the lack of any record of *Orthophragmina* the fauna of the Ocala limestone in Peninsular Florida appeared discrepant in comparison with other upper Eocene faunas. Careful examination of samples of Ocala limestone from Ocala, near Citra, and near Gainesville, Florida, has resulted in the discovery of abundant specimens of *Orthophragmina* (*Discocyclina*) *flintensis* Cushman near Gainesville, and a very similar, but new, species at the other localities, and, thereby, has harmonized with other upper Eocene faunas the foraminiferal fauna of the Ocala limestone of Peninsular Florida.

Horizon of the Topotypes of Lepidocyclina Vaughani.—The topotypes of *Lepidocyclina vaughani* do not come from the Emperador limestone of Panama, as MacDonald supposed.[7] Since *Lepidocyclina canellei*, which appears to be restricted to beds of the age of the Culebra formation, occurs with *L. vaughani* at the type locality, the type of *L. vaughani* belongs in the Culebra formation, a conclusion which is also supported by stratigraphic evidence. The specimens identified by Cushman as *L. vaughani* from the exposures near Miraflores Locks, Panama,[8] referred to the Emperador limestone, represent another species, to which the name *Lepidocyclina miraflorensis* Vaughan, nom. nov., is here applied. This discrimination removes the confusion that resulted from the erroneous correlation with one another of two distinct formations, of which the Culebra is the older.

Lepidocyclina Vaughani Cushman and L. canellei Lem. and R. Douv. in the Island of Antigua.—Recently Mr. W. R. Forrest has submitted to me specimens of *Lepidocyclina vaughani* and *L. canellei* Lem. and R. Douv. from Half Moon Bay, Antigua. The exposures at this locality can, therefore, be correlated with the Culebra formation of Panama. Detailed information on the stratigraphy at Half Moon Bay is lacking; but, from my studies in Antigua in 1914 and from information contributed by Mr. Forrest, my inference is that the beds that contain *L. vaughani* and *L. canellei* lie stratigraphically a little higher than the middle Oligocene Antigua formation and are approximately the equivalent of the European Chattian.

Oligocene Deposits in Northern Colombia.—The presence of a great development of Miocene deposits and of Eocene deposits in northern Colombia has been known for some time, but deposits of Oligocene age had not been recognized. Recently Mr. H. S. Gale has submitted to me specimens of Foraminifera, mostly from localities in the Department of Bolivar, representing at least two horizons. The collection from the lower horizon contain specimens of *Lepidocyclina* sp. aff. *L. crassata* Cushman and *Lepidocyclina* sp. aff. *L. Gigas* Cushman. A higher bed contains *Lepidocyclina canellei* var. *yurnagunensis* Cushman. These fossils and their stratigraphic relations indicate that there are in northern Colombia deposits of middle and upper Oligocene age. All of the larger divisions of the Tertiary, therefore, are well represented in that part of South America.

The Embryonic and Meridional Chambers of American species of Lepidocycline Foraminifera.—Lemoine and R. Douvillé, H. Douvillé, and J. A. Cushman have published valuable but insufficient information on the embryonic and meridional chambers of the American Lepidocycline Foraminifera. Specimens of most of the American species have recently been sectioned in the horizontal plane and photographs, enlarged 20 times, have been made. The meridional chambers can now be described for nearly all the American species of which specimens are available; and the embryonic chambers are now known for between 35 and 40 species, including the species investigated by previous students. The classification of types of embryonic chambers proposed by H. Douvillé is adopted for the present, although modification may later be made. There is doubt as to the constancy of the type of embryonic chambers in all individuals of the same species. The following types are recognized:

(1) Embryonic chambers composed of more than two chambers, arrangement spiral, subspiral, or not entirely definite, *Pliolepidina* of H. Douvillé. Example, an undescribed species from the Eocene of Chiapas. Type species not designated, but *L. tobleri* H. Douvillé may be taken as the type. This type is common in the upper Eocene and seems to extend into the Oligocene.

(2) Central chamber partly enveloped by an outer chamber, *Nephrolepidina* of H. Douvillé. Example, *L. fragilis* Cushman, probably basal Oligocene, Marianna, Florida. Type species, *L. marginata* (Mich't.). Other examples are *L. floridana* Cushman, *L. chattahoocheensis* Cushman, and *L. vaughani* Cushman. Upper Eocene and Oligocene.

(3) Initial chamber thin-walled, enveloped by an outer thicker-walled chamber and attached to the wall of the enveloping chamber, *Eulepidina* of H. Douvillé. Example, *L. favosa* Cushman. Type *L. dilatata* (Mich't.). *L. raulini* Lem. and R. Douvillé also typical. At present known only in the middle Oligocene of America.

(4) Two embryonic chambers, subequal in size, *Lepidocyclina* s. s. Typified by *L. mantelli* (Morton), the genotype of *Lepidocyclina* Gümbel. H. Douvillé has proposed the invalid subgeneric name *Isolepidina* for this group. Other species having this type of embryonic chambers are *L. canellei* Lem. and R. Douv., *L. supera* (Conrad), *L. miraflorensis* Vaughan, *L. parvula* Cushman. Geologic range upper Eocene and Oligocene.

The following types of meridional chambers have been recognized:

(1) Chambers arranged in intersecting, outwardly convex curves.

(*a*) Walls of inner (proximal) half of the chamber converge to an acute or an obtuse apex; outer (distal) wall convex outwardly. Most of the Eocene species possess this kind of meridional chambers. Typeform, a new species from Chiapas, Mexico. The meridional chambers of this type are very like those of true *Orbitoides*, type *O. media* (d'Archiac).

(*b*) Walls of the chambers forming hexagons. Typified by *L. mantelli* (Morton). This is the common Oligocene type; to it belong *L. supera* (Conrad), *L. canellei* Lem. and R. Douv., *L. miraflorensis* Vaughan, and many other species. It is also represented in the upper Eocene by *L. georgiana* Cushman and other species.

(*c*) Plan of the chamber walls intermediate between (*a*) and (*b*). Typified by *L. mortoni* Cushman and *L. ocalana* Cushman. Species belonging in this category occur at the top of the Eocene.

(*d*) Chambers either quadrangular (nearly square) or rhomboid, one corner directed proximally, the other distally. Typified by *Lepidocyclina vaughani* Cushman. *Lepidocyclina duplicata* Cushman and *Lepidocyclina hayesi* (Cushman) Vaughan are other examples. Chambers of types (*a*) and (*b*), above, grade into this type. The stratigraphic range is from probably upper Eocene to late Oligocene.

(2) Chambers arranged radially.

(*e*) Another type of meridional chambers may be suggested: Example, *L. antillea* Cushman of the Eocene of St. Bartholomew, W. I. The shape of the meridional chamber is somewhat similar to (*a*), above, but the tangential diagonal is longer than the radial and the arrangement is approximately along radial lines and not distinctly according to inter-

secting curves. Embryonic chambers in microspheric form a rather closely coiled spiral.

Most of the American species of Lepidocycline Foraminifera can now be referred to the categories above indicated. The investigation here outlined is leading to a more refined classification of the organisms considered and, consequently, more accurate geologic correlations. It also promises to throw considerable light on the evolution of *Lepidocyclina* and related genera. Even now it seems that there is an evolutionary sequence from the more ancient Eocene forms, which have meridional chambers with more or less pointed inner ends and curved outer walls, to the species with hexagonal and rhomboid chambers; and from *Pliolepidina* to *Lepidocyclina*, s. s. But before the investigation can be brought to a satisfactory end, other morphological features need careful study, and all the features must be evaluated systematically, stratigraphically, and phylogenetically.

Lepidocyclina miraflorensis Vaughan, n. sp.

Lepidocyclina vaughani (part.) Cushman, U. S. Nat. Mus. Bull., 103, p. 93, pl. 37, figs. 1, 2, 3, and 5 (not pl. 37, fig. 4, nor pl. 38), 1919.

Lepidocyclina vaughani (part.) Cushman, U. S. Geol. Survey Prof. Paper, 125, p. 64, 1920.

Lepidocyclina miraflorensis is of about the same diameter, 10 mm., as *L. vaughani*, and both are sublenticular in form, but they differ in the following details: The margins of *L. miraflorensis* are somewhat swollen but are rounded, not so much thickened and abruptly truncate as in *L. vaughani*. There are no stout pillars in the vertical sections of *L. miraflorensis*, while there are such pillars in *L. vaughani*. The embryonic chambers of *L. miraflorensis* are subequal (see pl. 37, fig. 3, of Cushman's paper cited above), while those of *L. vaughani* are of the *Nephrolepidina* type. The meridional chambers of *L. miraflorensis* are hexagonal, while those of *L. vaughani* are quadrangular or rhomboid.

Type locality: Half a mile south of Miraflores Locks, Panama Canal Zone, limy sandstone that appears to belong to the Emperador limestone, U. S. G. S. Station 6255. Collection by Dr. D. F. MacDonald.

Cotypes: U. S. National Museum.

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